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FIRST RESULTS FROM A LABORATORY FACILITY FOR MEASUREMENT OF EMISSION SPECTRA UNDER SIMULATED PLANETARY CONDITIONS. Paul G. Lucey, Natalie Domergue-Schmidt, Planetary Geosciences, Department of Geology and Geophysics, U. of Hawaii at Manoa, Bradley G. Henderson and Bruce Jakosky, LASP, U. Colorado.

We have developed a laboratory spectroscopic facility for the measurement of emission spectra under simulated planetary conditions. Spectral measurements are made from 6 to 13 microns with a scanning grating monochromator equipped with a HgCdTl detector. An environment chamber in in service in Hawaii for several years in which we can control the temperature from 77K to 500K, the pressure from 10^{-5} torr to two atmospheres, has been equipped with a 77K or 273K cold shield. The shield serves to minimize light reflected off the sample and to aid in development of thermal gradients for obtaining spectra under conditions simulating the thermal environment of airless bodies. Samples are placed in small cups on a temperature controlled substrate allowing measurements of emission due to heating from below by the substrate, or from illumination from a solar simulation source. Figure 1 is a sketch of the environment chamber system.

The data presented here show the emission from a fine-grained quartz sample heated from below at 100°C under ambient conditions with no cold shield, the same sample inside the environment chamber filled with 1 atmosphere of nitrogen with the shield cooled to 77K, and under vacuum conditions with 77K cold shield. In the chamber, a reentrant cavity is attached to the bottom of the cooled radiation shield to serve as a cold reference for measurement of instrument background. A second reentrant cavity is attached to the heater substrate to serve as a hot blackbody reference. The temperature of the substrate is measured with a platinum resistance thermometer. For each of the spectra shown in Figure 2, separate cold and hot reference spectra were obtained. The spectra shown were calculated from sample minus cold reference divided by hot reference minus cold reference. The resultant spectra shown in Figure 2 are in terms of relative emission, that is, sample over blackbody reference. Additionally, the spectra were multiplied by a Planck function calculated for the measured hot substrate temperature and divided by an estimate of the temperature of the sample (300K), and offset by .1 units to facilitate comparison. The spectra shown are of the same sample of quartz ground to a mean grain size of 10 microns using a shatterbox and ball grinder, size determined through SEM photography, placed in a glass sample cup and heated from below. The sample thickness was about 5mm, and the diameter of sample cup is near 10 mm. Temperature control was rather poor allowing slow monotonic drifts of several kelvins of the hot substrate during data collection. The upper two spectra were taken under vacuum conditions and are in qualitative agreement. They show a substantial inflection near 9.5 microns and a small emission feature near 11.5 microns. While some systematic error causing these features cannot be ruled out at this time, the sample chamber was flooded with dry nitrogen to eliminate thermal gradients via convective heat transport within the sample, and the spectrum obtained under these conditions, the third from the bottom and labeled A1, does not show these features. The bottom spectrum, shown with error bars, was obtained under ambient conditions without a cold shield with increased integration time. This spectrum is contaminated by about 10-20% reflected room background light as determined by measuring the flux reflected from a 77K diffuse gold standard placed in the sample position. This spectrum shows a very weak quartz doublet and is qualitatively similar to the spectrum obtained in the chamber under 1 atmosphere of nitrogen with a cold shield.

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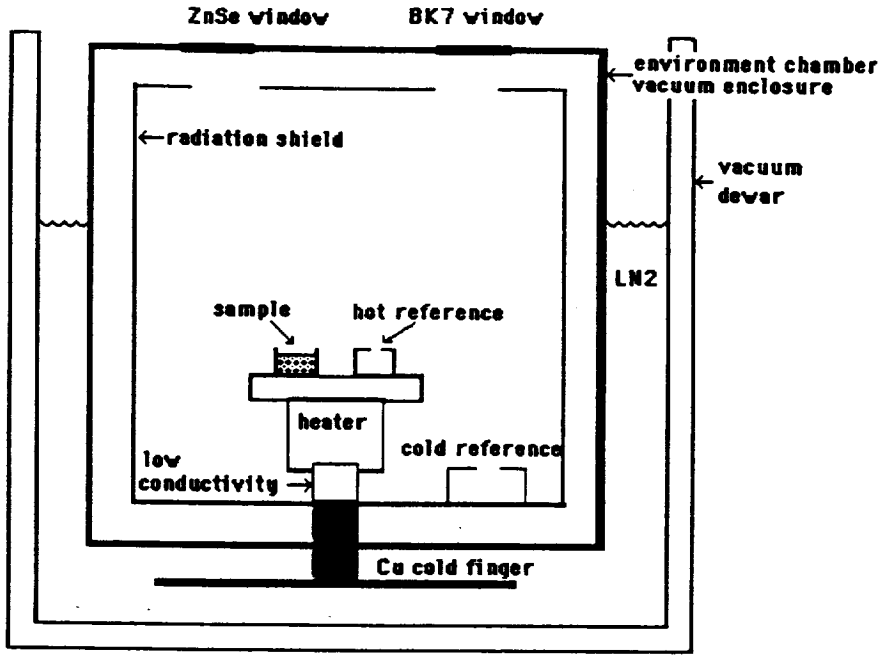

Figure 1. Schematic diagram of the environment chamber.

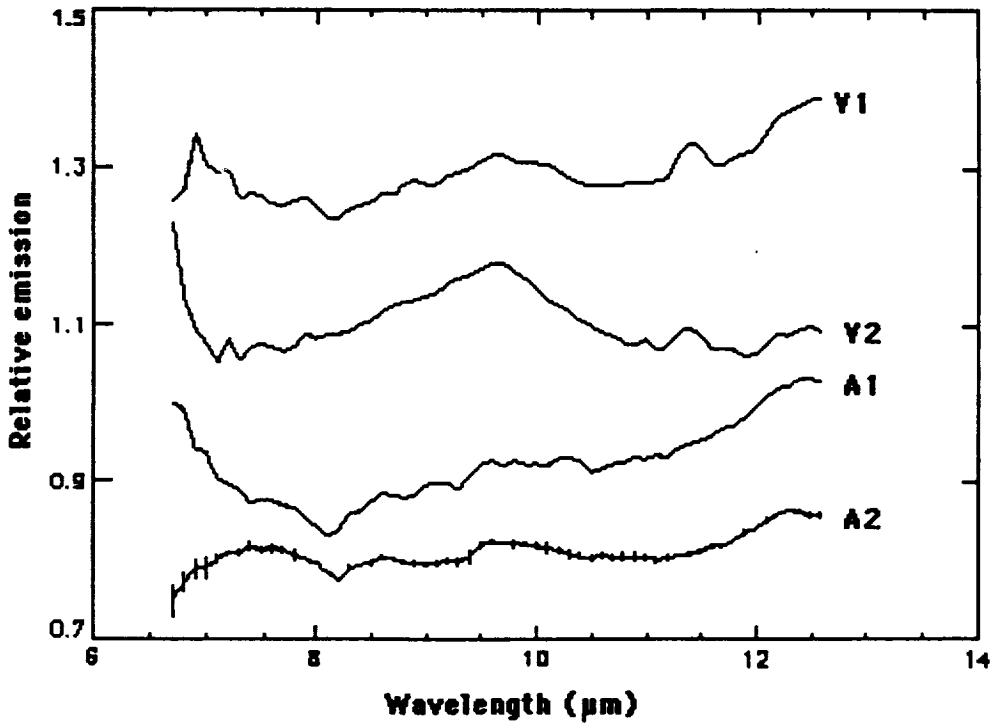

Figure 2. Spectra obtained under vacuum conditions (V1 and V2), 1 atm of nitrogen in the chamber with a 77K cold shield (A1), and in air without cold shield (A2).